Executive Summary

I. INTRODUCTION

The *Cleaner Technologies Substitutes Assessment* (CTSA): *Lithographic Blanket Washes* is a technical report that presents the performance, cost and risk information developed by the EPA Design for the Environment (DfE) Lithography Project on 37 blanket washes solutions (36 substitute washes and a baseline wash) that are used to remove ink and debris from the printing press rollers. The assessment focuses on small print shops that use sheetfed, non-heat set lithographic presses less than 26 inches wide and that clean their presses manually. It includes all the technical information gathered during the Project, including the methodologies used to develop the performance, cost, and environmental information.

The goal of the DfE Lithography Project is to work with the printing industry to develop a comparative assessment of blanket washes used by lithographers. The assessment is intended to provide lithographers with information that can assist them in making decisions that incorporate environmental concerns along with cost and performance information when purchasing blanket washes. Although the Lithography Project was designed to assist small printers who may have limited time or resources to compare blanket washes, the primary audience for the CTSA is environmental health and safety personnel, chemical and equipment manufacturers and suppliers in the lithographic printing industry, and other technically informed decision makers. The information contained in the CTSA will form the basis of a variety of user-friendly information products designed specifically for small business printers who are interested in choosing a new blanket wash. These products will include case studies, bulletins, and brochures.

The information in the CTSA was developed from a variety of sources. Data on performance and cost were derived from real world performance demonstrations conducted both in the laboratory and in actual printing facilities. The laboratory tests provided information on the chemical characteristics of the blanket washes such as blanket swell and wipability. Demonstrations at print shops provided field data for the performance and cost assessments. Exposure, hazard, and risk assessments for the chemical components of the blanket washes were made by the EPA based on available data and modeling where data were not available. All assumptions used in developing the information in the CTSA, such as number of blankets per press, size of each blanket, or amount of wash used, were reviewed by representatives of the printing industry.

II. DESIGN FOR THE ENVIRONMENT LITHOGRAPHY PROJECT

The DfE Lithography Project is a joint effort of the Office of Pollution Prevention and Toxics (OPPT) and The University of Tennessee Center for Clean Products and Clean Technologies, in a voluntary and cooperative partnership with the Printing Industries of America (PIA), the Environmental Conservation Board of the Graphic Communications Industry (ECB), and the Graphic Arts Technical Foundation (GATF). The DfE Program began working with the printing industry in 1992, when the PIA requested EPA's assistance in evaluating environmental claims for products.

The DfE Lithography Project partners chose to compare the environmental and human health risks of manual blanket washing because traditionally these products are petroleum-based solvents with a high volatile organic compound (VOC) content. For example, a commonly used

What is the Design for the Environment Program ?

The Design for the Environment (DfE) Program harnesses EPA's expertise and leadership to facilitate information exchange and research on risk reduction and pollution prevention efforts. DfE works with businesses on a voluntary basis, and its wide-ranging projects include:

- Assisting businesses in incorporating environmental concerns into decision-making processes.
- Working with specific industries to evaluate the risks, performance, and costs of alternative chemicals, processes, and technologies.
- Helping individual businesses undertake environmental design efforts through the application of specific tools and methods.

DfE partners include:

- Industry
- Professional Institutions
- Academia
- Environmental Groups
- Public Interest Groups
- Other Government Agencies

solvent is VM&P naphtha, which is 100 percent volatile. The high VOC-content blanket washes currently used by many printers may pose a potential risk to workers' health and to the environment. In addition, VOCs have been implicated in the formation of ground level ozone. As a result of the potential adverse effects that may result from the release of VOCs from blanket washes and from other applications, the EPA and some states are considering regulations that may impose restrictions on the use and emissions of products containing VOCs and Hazardous Air Pollutants (HAPs). Many states have already implemented regulations aimed at reducing VOC emissions even from small printers. The DfE Lithography Project partners hope that helping printers, large and small, identify effective and competitively-priced blanket washes with lower VOC content will result in improved air quality in both printing facilities and in the ambient air.

The project partners decided that the DfE Lithography Project would focus on the concerns of small printers. Unlike many large printers who may have staff that are familiar with, or have access to, current information about new and developing products and technologies, most smaller printers are unlikely to have the staff, time, or resources to investigate the latest innovations. To respond to the concerns of these smaller printers, the DfE Lithography Project partners agreed that the primary goal of the project would be the assessment of manual blanket washes as they are typically used in smaller print shops.

In order to be evaluated by the Project, the blanket washes had to meet several criteria: (1) they needed to be commercially available, (2) they had to be voluntarily donated by the supplier, and (3) the complete formulations had to be disclosed to EPA for risk assessment purposes (although the exact composition was treated as confidential by EPA and not disclosed to printers or other outside parties). In all, 36 blanket washes and VM&P naphtha (baseline), donated by 19 suppliers, were included in the Project.

To provide a basis for comparison among the blanket washes, a baseline blanket wash was selected. VM&P naphtha, which is composed of 100 percent light aliphatic solvent naphtha, was chosen as the baseline because the Project partners believed that most printers would already be familiar with how VM&P naphtha performs and that it would be a useful point of reference for the evaluation of the substitute washes. VM&P naphtha is highly effective in cleaning blankets and relatively inexpensive and, therefore, provides an excellent standard against which to compare the cost and performance of the substitute blanket washes.

III. CLEANER TECHNOLOGIES SUBSTITUTES ASSESSMENT

Summary of Results

Based on the hazard and exposure information collected and analyzed for the blanket washes, risk estimates were determined for both the general population, i.e., people living near a printing facility who may be exposed to contaminated air or water, as well as for workers at the printing facilities. Risk estimates associated with the chemicals in the blanket washes were negligible for the general population. Twenty-seven of the 37 blanket washes had some occupational risks associated with them, primarily from dermal exposure. Possible adverse effects from dermal exposure (and some inhalation exposure) included blood abnormalities, reproductive/developmental problems, or the presence of carcinogens. Proper protective equipment would substantially reduce or eliminate these risks to workers.

Prior to demonstration of the blanket washes in a print shop, the 36 substitute blanket washes were tested in the laboratory for blanket swell potential and wipability. Of the 36 washes, 22 were deemed to be satisfactory for demonstrations at volunteer printing shops (two shops demonstrated each blanket wash). The results of the performance demonstrations were highly variable between the two print shops using a particular blanket wash and among the many blanket washes themselves. Performance varied to a great extent based on the amount of ink coverage. Excluding trials with heavy ink coverage, eleven washes gave good or fair performances at both facilities, seven washes gave good or fair performance at one facility but not the other, and the remaining four washes performed poorly at both facilities.

The costs of using the substitute blanket washes were also highly variable even when normalized for costs such as wages, number of blankets cleaned, etc. Compared with the use of the baseline, VM&P naphtha, most of the substitute blanket washes resulted in increased costs; however, five blanket washes did result in lower costs for at least one of the demonstration facilities, and one resulted in lower costs at both facilities. The cost of using the blanket wash was most dependent on the amount of time required to clean the blanket. This cost was likely higher due to the press operators' lack of familiarity with the new products.

Data Collection

Determining the risks of the substitute blanket washes required information on the chemicals in each blanket wash formulation (a blanket wash is usually a mixture of several chemicals including solvents; the exact chemicals and their proportions define the formulation). Specifically, each blanket wash formulation was broken down into its chemical components, and data were gathered on each individual chemical. In order to maintain the confidentiality of the formulations, EPA genericized the specific chemicals in the formulations into chemical categories (Chapter 2, Section 1). For example, if a formulation contained dodecyl benzenesulfonic acid or sodium xylene sulfonate, both of these chemicals were designated by the chemical category alkyl benzene sulfonates. Similarly, if one formulation contained solvent naphtha and another formulation contained xylene, both of these chemicals would be categorized as aromatic hydrocarbons. Although the actual percentage of each component in the mixture was used in the assessment, this information was not provided in the CTSA to maintain the confidentiality of the proprietary formulations. The actual composition of the formulations was thus kept confidential while still providing an indication of the type of chemical that could pose a hazard.

<u>Chemical Information</u>

For each of the 56 chemicals included in the 37 blanket wash formulations, the chemical properties and selected environmental fate properties were determined and are presented in Chapter 2, Section 2. Properties that were measured or estimated (using a variety of standard

Project Considerations

There are limitations associated with the analysis that was conducted in the project. Some of the global limitations are listed below, other limitations, specific to a particular portion of the assessment, are given in the applicable sections.

- This assessment focuses on the use of manual blanket washes in small lithographic printing facilities using only one press with four color units. Exposure estimates related to blanket wash use in larger facilities may be higher.
- The exposure and risk estimates reflect a small portion of the potential exposures within a lithographic printing facility. Many of the chemicals found in these formulations may also be present in the inks or other cleaning solvents used in a shop. Incremental reduction of exposures from blanket wash use will reduce cumulative exposures from all sources in a printing facility.
- The risks associated with volatile organic compound (VOC) releases were not examined in this assessment. Because VOC releases are a driving factor behind current regulations affecting printers, VOC content for the formulations are given at the request of industry participants. The concerns associated with VOC releases are addressed by federal, state, and local regulations and were not re-evaluated here.
- The regulatory information contained in the CTSA may be useful in moving away from chemicals that trigger compliance issues, however this document is not intended to provide compliance assistance. If the reader has questions regarding compliance concerns they should contact their federal, state, or local regulatory authorities.
- The 37 blanket wash formulations assessed in this report were voluntarily submitted by participating suppliers and are not intended to be representative of the entire blanket wash market.
- The performance and cost data are not based on rigorous scientific studies. This information is subjective and is based on limited data points.
- Screening-level risk characterization techniques were used. The risk characterization results, therefore, contain limitations regarding confidence.

EPA methods) included melting point, solubility, vapor pressure, soil sorption coefficient, octanol water partition coefficient, boiling point, and flash point. Presentation of these properties allows for the determination of the environmental fate of these chemicals when they are released to the various media such as landfills, publicly-owned treatment works, surface waters, and soil.

Health Hazard Assessments

Inherent in determining any risk associated with these chemicals is a determination of the hazard or toxicity of the chemical as presented in Section 2.3. Many of the chemicals in the blanket wash formulations have been studied to determine their health effects. In order to determine those chemicals for which testing data were available, literature searches were conducted of on-line databases including the EPA's Integrated Risk Information System (IRIS), the National Library of Medicine's Hazardous Substances Data Bank (HSDB), TOXLINE, TOXLIT, GENETOX, and the Registry of Toxic Effects of Chemical Substances (RTECS).

For many of the chemicals, EPA has identified chemical concentrations that are known to be hazardous (e.g., no- or lowest-observed adverse effect level [NOAEL or LOAEL]) or levels that are protective of human health (reference concentration or reference dose). These values were taken from published literature. For those chemicals lacking toxicity data, EPA's Structure-Activity Team estimated human health concerns based on analogous chemicals. The adverse effects associated with these chemicals include cancer, chronic effects on various organs such as the liver or kidney, effects on developing fetuses, genetic mutations or aberrations, gastrointestinal effects, effects on blood, nervous system, and respiratory system, and effects on the reproductive capabilities of males or females. The toxicity values, route of exposure, and adverse effects for each chemical are listed in Table 2-3. This information is combined with estimated exposure levels to develop an estimate of the risk associated with each chemical.

Ecological Hazard Assessments

Similar information was gathered on the ecological effects that may be expected if these chemicals are released to water. Acute and chronic aquatic toxicity values were estimated by EPA using structure-activity relationship software developed for that purpose and verified by comparison with data in the available literature. For discrete organic chemicals such as xylene, a structure-activity relationship was used to predict the acute and chronic toxicity to fish, aquatic invertebrates, and algae. For petroleum products such as mineral spirits, which are mixtures and have undefined compositions, toxicity values were determined by estimating the toxicity of each individual constituent and then evaluating the hazard of the product based on the constituents. Aquatic toxicity values were identified from on-line database searches (TOXLINE and AQUIRE) for comparison. Based on the toxicity values, the 56 chemicals were ranked according to their hazard concern as high (8 chemicals), moderate (29 chemicals), or low (19 chemicals). Aquatic toxicity data for the one inorganic chemical in the formulations, sodium hydroxide, indicated that the lowest chronic aquatic toxicity value was 100 mg/L, and therefore, of low aquatic toxicity concern.

Federal Regulatory Status

Several regulatory lists were searched for blanket wash chemicals that might trigger federal regulatory requirements. The presence of federally-regulated chemicals in a blanket wash formulation may influence a printer's decision to use that formulation. Ten of the 56 chemicals in the blanket wash formulations are subject to various federal environmental regulations. These chemicals are 1,2,4-trimethyl benzene, cumene, diethanolamine, diethylene glycol monobutyl ether, dodecylbenzene sulfonic acid, N-methylpyrrolidone, sodium bis(ethylhexyl) sulfosuccinate, sodium hydroxide, Stoddard solvent, and xylene. Among the regulations that apply to one or more of these chemicals are the Clean Water Act, the Clean Air Act, CERCLA, SARA, and RCRA. Reporting and other requirements may affect the use, storage, and disposal of these chemicals under these or other statutes.

Safety Hazards

Because of the many volatile, or otherwise hazardous chemicals in the blanket wash formulations, four safety factors are provided for each formulation. Safety data on the reactivity, flammability, ignitability, and corrosivity of the actual blanket wash formulations containing these chemicals are included in Section 2.6. This information was obtained from Material Safety Data Sheets provided by the suppliers. Factors are based on the National Fire Protection Association's ranking for reactivity and flammability.

Results

In order to characterize the general population and occupational risks associated with the blanket wash chemicals, exposure information was estimated and then combined with the hazard information identified in Chapter 2. Exposure levels used in the risk assessment were based on estimated environmental release data. Releases from a model printing facility were estimated based on models and the resulting exposures to the general population were then developed. Occupational exposure to the blanket washes were also determined. The specific methods and results of the exposure and risk assessments are described below.

Exposure Assessment

In order to assess the risks, it is important to understand not only the hazards posed by the chemicals or blanket wash formulations, but also to know how people or the environment may be exposed to the chemicals from their use as blanket washes. EPA used a materials balance approach for calculating releases of lithographic blanket washes from printing facilities (Chapter 3, Section 1). This approach assumes that: (1) 160 gallons of blanket wash are purchased per year by a facility, (2) all of the blanket wash is either released to air in the shop (and eventually to the outdoors) or is left on the cleaning wipes which are laundered with subsequent releases to water, and (3) release of the blanket wash to air is dependent on the vapor pressure of the chemicals in the formulation. Depending on the composition of the blanket wash (i.e., VOC content and density of the components), potential environmental releases to air and water were calculated for each of the chemicals in the formulations. Releases to air ranged from non-existent to 0.07 g/sec for terpenes in Formulation 25. Releases to water ranged from non-existent to as much as 604 kg/year for fatty acid derivatives in Formulation 26.

Potential worker exposures were evaluated (Chapter 3, Section 2). As with the environmental release estimates, certain assumptions must be made such as the number of times a worker cleans the blankets per shift, the length of time required to clean a blanket and the amount of wash used. To assure that these assumptions were indicative of "real world" print shops, they were reviewed by lithographic industry representatives and adjusted as necessary. Chemicals with vapor pressures of less than 10^{-3} mm mercury were assumed to have no inhalation potential because they would not volatilize. Inhalation exposures were negligible for most of the formulations; however, some formulations that contained chemicals such as petroleum distillate hydrocarbons, aromatic hydrocarbons, and terpenes did have significant inhalation potential (up to 240 mg/day). Dermal exposures from contact with the blanket wash solution during cleaning activities were estimated based on the type of operation and the concentration of the wash (some washes were diluted prior to use). Dermal exposure tended to be high for all formulations, with levels exceeding 3,000 mg/day for certain chemicals in 12 formulations. All dermal exposures would be negligible if proper protective clothing was worn.

General population exposure based on the environmental releases described above were examined. Such exposure may occur by a variety of routes including breathing vapors of the formulations in air near the printing facilities or drinking contaminated water (Chapter 3, Section 3). Exposures for the general population were determined based on atmospheric modeling and surface water modeling and were used to develop the risk characterizations.

Two atmospheric exposure scenarios were used: local and regional. In the local scenario, releases from only a single "model" printing facility in normal operations were considered. Based on the atmospheric dispersion model, the lifetime average daily dose for an adult ranged from 1×10^{-4} mg/kg/day to 4.6×10^{-3} mg/kg/day. Denver, Colorado was chosen to evaluate the cumulative effects from several facilities in a community. Assumptions used in this exposure included: (1) 235 lithographers in Denver, (2) the 1990 population was approximately 470,000, (3) the area of Denver is 277 square kilometers. The resulting average daily doses for the population of Denver ranged from 1×10^{-5} to 1.3×10^{-3} mg/kg/day.

In addition to exposure from atmospheric releases, doses to people as a result of surface water releases from one printing facility (local) and all printers in the City of Denver (regional) were also estimated. These estimates were based on laundry cleaning of print shop towels containing blanket washes. All water releases were assumed to go to the local publicly owned treatment works before release to a water body. Assumptions regarding human intake included: (1) people drink an average of two liters of water a day, (2) some chemicals bioaccumulate in fish, and (3) people eat an average of 16.9 grams of fish per day. For a population around a single facility, daily human doses based on fish ingestion were generally 2 to 3 orders of magnitude greater than for ingestion of contaminated drinking water (0 to 0.1 mg/year for water compared with 0 to 500 mg/year for fish). Daily doses for residents of Denver fluctuated greatly, although the doses were consistently greater for fish ingestion compared with drinking water ingestion.

Risk Characterization

By combining the hazard information presented in Chapter 2 with the exposure data for the blanket wash formulations from Section 1 of Chapter 3, the risks posed by these mixtures was characterized. The risks determined for the formulations (or the chemicals that compose them) may then be compared with established risk values for the various chemicals such as Reference Doses, Reference Concentrations, NOAELs, and LOAELs. A ratio of the estimated risk to the known risk provides a margin of exposure. General population risks were found to be non-existent whether exposure resulted from drinking water, fish ingestion, or inhalation of ambient air. Worker risks were generally associated with one or two chemicals in a given blanket wash formulation. Twenty-seven of the 37 blanket washes posed some risk from dermal exposures. The concern for risks tended to be for blood effects, some reproductive or developmental effects, and the possible presence of carcinogens. In some cases, the margin of exposure was less than 10 suggesting that adverse health effects were of concern under realistic exposure situations. Worker inhalation risks were very low as a result of the relatively low exposure levels; only formulation 3 posed any inhalation concerns.

Risks in the workplace associated with dermal exposure to the blanket washes may be substantially reduced by the use of proper protective equipment and clothing such as gloves, goggles, and aprons. Inhalation risks may be reduced by proper ventilation of the facility and the use of blanket washes with low VOC content.

Two chemicals contained in the blanket wash formulations may present risks to aquatic organisms. The two chemicals were alkyl benzene sulfonates, present in Formulations 3, 4, 6, 8, 11, 18, and 20, and ethoxylated nonylphenols, present in Formulations 4, 5, 7, 8, 9, 17, 24, and 40. Risks to plants (other than aquatic algae) and wildlife were not examined.

Performance Demonstrations

In order to be a viable substitute for existing blanket wash formulations, the alternative formulations must effectively clean the press blankets. To determine how effective the 36 blanket washes were compared to the baseline wash, the Project partners decided that both laboratory testing and field demonstration were necessary. The laboratory tests, conducted by the Graphic Arts Technical Foundation, focused on the physical properties of the blanket wash formulations such as flash point, VOC content, and pH (as distinct from the individual chemicals components of the mixtures discussed in Chapters 2 and 3). Also to ensure that presses at the volunteer facilities would not be damaged, blanket swell potential and wipability tests were also conducted. Any wash where the blanket swell exceeded 3 percent or where more than 100 strokes were required to clean the test blanket were eliminated for consideration for field testing. Based on the results of the laboratory testing, 22 formulations went on to be demonstrated by volunteer printing shops.

In the laboratory tests, the flash points of the blanket washes ranged from 50°F to greater than 230°F; the VOC content ranged from 0.05 lbs/gallon to 7.2 lbs/gallon (0.6 to 99% VOC, respectively); and the pH ranged from 3.4 to 9.9. There was no correlation between the three properties in the formulations. Blanket swell was measured at 1 and 5 hours with 13 formulations having greater than 3 percent swelling at 5 hours. Wipability was tested using both wet ink and dry ink films. Two formulations required more than 100 strokes to clean dry ink.

Field demonstrations were conducted at 17 printing facilities in the Boston, Baltimore, and Washington, DC areas. Each formulation was used by pressmen in two facilities for 1 week. DfE "observers" provided background information to the printers and collected information during the first day's use of the blanket wash. The trade names were removed and each formulation was assigned a number. Neither the pressman nor the observer knew the company supplying the formulation or its components. Each pressman used the baseline wash, VM&P naphtha, for 2-4 cleanings and then began use of the substitute for the remainder of the week. The printers recorded amount of effort and a qualitative assessment of performance as compared to the baseline. They also collected volume used per wash, ink coverage, amount of effort, time required, and a qualitative assessment of performance during the one-week trial. At the end of the week, the observer conducted a follow-up interview with the printer. Results of these performance demonstrations in the laboratory and in the field are detailed in Chapter 4, Section 1.

The circumstances under which the blanket wash formulations were demonstrated at printing facilities were highly variable (i.e., operating conditions, types of print jobs, staff attitudes and aptitude, application method) and the short time during which the formulations were used preclude making generalizations regarding the long-term performance of the blanket washes. In Chapter 4, the performance evaluations for each of the blanket washes are summarized with an indication of how the product performed at each printing facility. Some printers used a particular substitute blanket wash on only four blankets before indicating that the product gave unacceptable results. However, some print shops cleaned more than 30 blankets (one shop tested 61 blankets). In several cases, there was considerable variation between the results obtained for the two facilities testing a single formulation. For example, Blanket Wash 3 gave good results compared with the baseline wash at one facility which used it on ten blankets and found that it gave good performance with light or medium ink coverage, whereas the second facility which tested it on four blankets thought that it gave poor performance compared with the baseline wash without indicating the level of ink coverage.

Of the blanket washes demonstrated, nine were found to give good or fair performance at both facilities with light to moderate ink cover when compared with the baseline wash, although poor results were frequently seen with heavy ink cover. Five of the formulations gave poor results at both testing facilities regardless of the ink cover and eight were found to give good or fair results at one facility and poor results at the second facility. Performance was not correlated with VOC content; however the baseline wash which has a very high VOC content generally gave good results. An in-depth description of the performance of each blanket wash at each test facility is described and compared with the baseline wash (VM&P naphtha) in Chapter 4, Section 1.

Cost Analyses

Data collected during the performance demonstrations and from the suppliers were used to estimate the relative costs of using the blanket wash substitutes and the baseline in a lithographic printing facility. Data was collected on both the baseline wash and the substitute washes in terms of volume of wash used and the time required for cleaning the blanket. Several assumptions, similar to the estimates in Chapter 3, had to be made in order to develop cost information. These assumptions included:

(1) there were four blankets per press;
(2) each blanket was washed ten times per shift;
(3) there were five 8-hours shifts per week for 50 weeks per year;

Based on these assumptions, it was possible to estimate the total cost/wash; total cost/press; and total cost/press/shift/year for each formulation.

The cost calculations were comprised of several factors:

(1) labor costs (i.e., time spent to clean blankets) as a function of average wage rate;
(2) cost of the amount of wash used per blanket; and
(3) cost of the leased cloth wipes (cost of disposable wipes were not included).

Suppliers provided information on the purchase cost per gallon of the baseline and substitute blanket washes if purchased in a 55-gallon quantity. These costs ranged for $2.85/gallon for Formulation 32 to $20.00/gallon for Formulation 11 (the baseline formulation cost was $5.88/gallon).

When the cost of using the substitute blanket washes was compared with the cost of the baseline wash, most of the substitute blanket washes resulted in increased costs to at least one of the two printing facilities. The increased costs ranged from relatively insubstantial (4%) to more than twice the cost of the baseline (maximum increase 179%). Only five blanket washes resulted in lower costs at one facility, and of these, only one (Formulation 37) showed lower costs at both demonstration facilities. These costs, however, must be used with caution as in many cases the number of demonstrations on which the costs were based were extremely limited. In addition, conditions vary at each facility; what works in one may not work in another.

The driving factor for the cost estimates was the time needed to clean the blanket. No considered in this analysis is that the time required to clean the blanket potentially may decrease as the press operators become more familiar with using an alternative product.

IV. OTHER ISSUES

Many factors influence a printer's decision to use a particular blanket wash. These considerations include performance, cost, and risk, but other factors may also play a role in individual situations. Some of these other factors, such as resource and energy conservation, were examined in the CTSA. In Chapter 5, situations where opportunities for reducing energy and resources consumption in the manufacturing, use and disposal of blanket washes are discussed in terms of product life cycle. For some factors, such as whether the use of reusable or disposable wipes is more likely to conserve resources, definite answers cannot be given. For other aspects of the blanket washes, such as chemical composition (petroleum versus vegetable-derived) and packaging (diluted versus concentrated formulation), it is more clear how resource conservation can be achieved. Many printers are concerned with waste disposal, and recycling appears to be a viable solution to reducing waste, in some circumstances.

In a recent survey, over 75 percent of responding printers indicated that they had tried one or more substitute blanket washes and almost half of them had altered their workplace practices to prevent pollution. Some of the techniques that these printers found useful are described in Chapter 6. Many of these practices had the added benefit of saving time, reducing costs, or both. Among the workplace practices and potential benefits described in Chapter 6 are raising employee awareness of the need for and use of protective equipment and pollution prevention practices, better management of materials (e.g., reducing amount of blanket wash used), improving processes (e.g., minimizing the amount of ink used or the length of a run), and management of waste (e.g., storing rags appropriately).

Techniques for recycling used solvent are the focus of Section 6.2. Extraction methods consisting of hand-operated wringers or explosion-proof centrifuges can be used to recover the solvent from wipes used during blanket washing. Once the solvent is extracted, it may be reused for less exacting cleaning needs. If a better quality solvent is desired, then the distillation or ultrafiltration techniques described here may be used to yield near virgin-quality solvent.

Chapter 7 provides summaries of the information developed in this CTSA, examines that information in a qualitative benefit/cost discussion, and presents the information on a formulation-by-formulation basis.

V. CONCLUSIONS

When the DfE Lithography Project was initiated, it was hoped that the Project partners would be able to provide guidance to lithographers, particularly small printing facilities, on the trade-offs among risk, performance, cost, and other factors associated with blanket washes. The Project partners realized that each print shop is different and that judgments on whether one blanket wash is better than another need to be made by individual printers; therefore, no rankings of the blanket wash formulations were made. Instead, the CTSA is a repository of all of the technical information on the blanket washes developed by the Project. It forms the basis for outreach products designed to convey these results to lithographic printers in simple, easy-to-use formats. The CTSA will, therefore, be a resource for those seeking in-depth information on blanket washes and their chemical components, as well as on other issues surrounding the use of manual blanket washes for lithographic printers.